

NATURAL HONEY TOXICANTS

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Although many nectar-bearing plants with toxic constituents are known, the incidence of human poisoning by honey is extremely low. Honeybees forage widely around their colony, and no doubt occasionally encounter sources of toxic nectar, but the predominating major nectar sources compete for their attention and provide great dilution of any toxic nectar collected. Additionally, some nectars are sufficiently toxic to bees to prevent their return to the hive^{2, 3}. This brief review includes only honeys that are toxic to humans. With regard to the major known sources of toxic honey, rhododendron and other members of the Ericaceae, the beekeeper is aware of the problem and ensures that honey suspected of this contamination does not reach the market. In New Zealand the problem of occasional appearance of an especially toxic honey is met by monitoring honey from test hives in suspected areas, and prohibiting beekeeping when toxic honey might be produced.

The likelihood of poisoning by commercially available honey is extremely small, because of the factors noted above and because blending of honey from different areas by beekeepers and packers would reduce concentrations of possible minor toxic materials well below any significant level.

The major sources of toxic honey are members of the Ericaceae, including *Rhododendron*, *Azalea*, *Andromeda* and *Kalmia* species; reports may be found dating back to the mass poisoning of the expedition of Cyrus in 401 BC near Trebizond in Asia Minor, presumed to have been due to honey from *Rhododendron ponticum*. The problem still recurs in the area. A number of toxins from these plants have been characterized and the toxicology studied.

A fascinating interdisciplinary investigation²¹ of a major occurrence of honey poisoning in New Zealand showed that the toxicity was produced from a constituent of the tree tutu (*Coriaria arborea*), by passage through leaf hoppers and excretion of toxic honeydew, which under certain conditions was collected by bees. Reports of human intoxication from other honeys are somewhat fragmentary and largely anecdotal; Kebler published a review as early as 1896¹². The toxic effects of a Hungarian honey have been ascribed to belladonna alkaloids from the nightshade⁶ as well as to scopolamine from *Datura metel*^{11, 19, 25}. Pellett²² quoted briefly from an article describing an incident in 1885 of fatal poisoning of three children by honey from yellow jessamine (*Gelsemium sempervirens*); twenty persons were affected¹². The toxin was stated to be gelsemine²⁸. Children have also been reported to be poisoned by sucking nectar from these flowers¹⁷.

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TABLE 1. Toxicants isolated from honey or nectar

<i>Compound</i>	<i>Source</i>	<i>Conc. (ppm)</i>	<i>Identification</i>	<i>Ref.</i>
acetylandromedol (grayanotoxin I, andromedotoxin, rhodotoxin, asebotoxin)	<i>Kalmia latifolia</i> honey	100	Electrophoresis, mixed mp, IR spectrum	27
	<i>Rhododendron thompsonii</i> nectar	108	mp and mixed mp, $[\alpha]_D$, IR spectra	3
andromedol (grayanotoxin III, deacetyl andromedotoxin)	unknown honey	7	TLC (3 solvents), 4 chromogens	24
anhydroandromedol	unknown honey	3	as above	24
desacetylpieristoxin B	unknown honey	>7	as above	24
tutin	honey containing honeydew from <i>Scolypopa australis</i> on <i>Coriaria arboria</i> (tree tutu)	20	mixed mp and IR spectra	7
hyenanchin	as above	160	as above	7
pyrrolizidine alkaloids (senecionine, seneciphylline, jacoline, jacobine, jacozone)	<i>Senecio jacobaea</i> honey	0.3-3.9	GLC — mass spectrometry	5

TABLE 2. Toxicity of compounds isolated from honey or nectar (see Table 1).
 LD₅₀ is given in mg/kg body weight.
 In column 4, IP = intraperitoneal; SC = subcutaneous.

Toxicant	LD ₅₀	Animal	Route	Ref.
acetylandromedol	1.28	♂ mouse	IP	26
	0.15	mouse	SC	14
	1	♀ mouse	IP	3
	3.9	frog	SC	14
andromedol	3.47	mouse	SC	14
	0.908	♂ mouse	IP	26
	5.08	frog	SC	14
desacetylpieristoxin B	0.65	mouse	SC	15
gelsemine	0.5*	rabbit	SC	23
gelsemine. HCl	4	mouse	IP	20
	0.8	rabbit	IP	23
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	LD ₇₅			
tutin	1.2	guinea-pig	stomach tube	21 III
	c.20	rat	stomach tube	21 III
	0.75	guinea-pig	SC	21 III
	c. 4	rat	SC	21 III
	0.7	guinea-pig	IP	21 III
	c. 5	rat	IP	21 III
hyenanchin	12	guinea-pig	stomach tube	21 III
	c.40-90	rat	stomach tube	21 III
	9	guinea-pig	SC	21 III
	c.30	rat	SC	21 III
	9	guinea-pig	IP	21 III
	9	guinea-pig	IP	21 III
	c.30	rat	IP	21 III

*lowest LD reported.

Attention has been drawn to the presence of pyrrolizidine alkaloids in honey produced when tansy ragwort (*Senecio jacobaea*) is in flower, but no instances of poisoning by ingestion of honey from this source have been reported. The chemistry, occurrence, and toxicity of these alkaloids, a major source of stock poisoning, have been reviewed¹.

Tests for the presence of andromedols^{24, 27}, and tutin and hyenanchin²⁶ are available.

Table 1 lists the natural toxicants so far identified in honey or nectar, and Fig. 1 shows their structure. Tables 2 and 3 give such information as is available on their toxicity, and symptoms of poisoning by them, respectively.

TABLE 3. Symptoms of poisoning by honey toxicants

	Experimental animals	Human subjects
andromedotoxins and related substances	dyspnoea, clonic convulsions, lardosis, paralysis, exophthalmos, sedation, respiratory failure ²⁴ . See Moran et al. ¹⁶ for pharmacological action of small doses.	numbness in extremities, tingling, weak pulse (30-50), loss of consciousness, recovery 1/2-10 h ¹⁰ ; tingling, indistinct vision, dizziness, nausea, vomiting, loss of enervation of voluntary muscles ⁹
tutin, hyenanchin	hypersensitivity, convulsions	delerium, giddiness, nausea, abdominal and head pain, vomiting, limb rigidity, convulsions, coma, loss of memory ^{21-III}
gelsemine	muscular weakness, convulsive head and leg movement, slow respiration, decreased temperature, excessive perspiration, respiratory failure ¹⁸	giddiness, blindness, lassitude, nausea, convulsions ²³

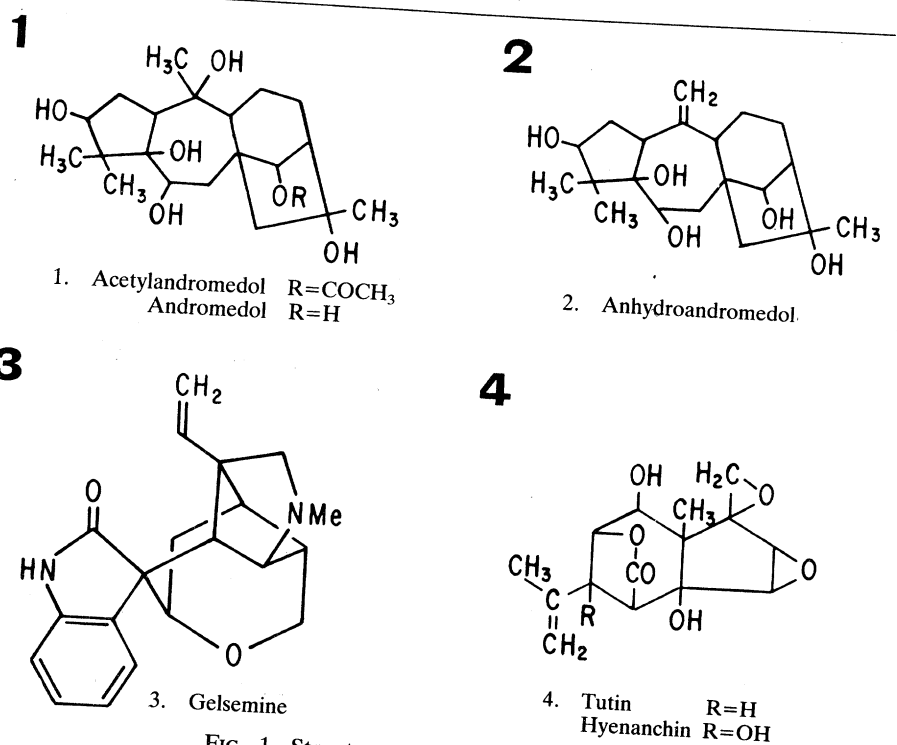


FIG. 1. Structures of honey toxicants

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